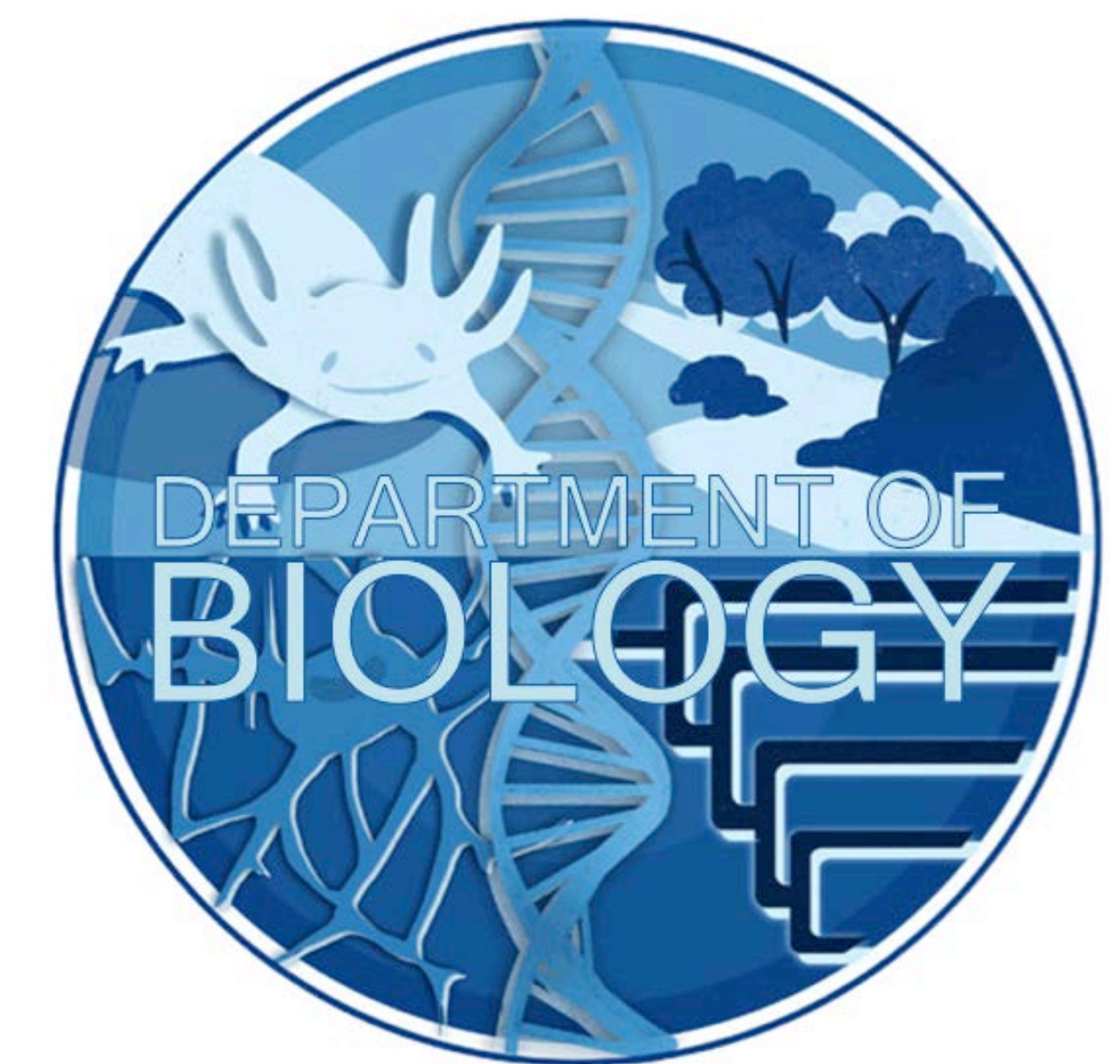


Active Study Guidance: Learning Through Practice

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Introduction

Metacognitive awareness, an ability to think about one's own thinking, is critical for effective learning. Accurate self-evaluation is an important component of metacognitive awareness. As a group, students enrolled in my Introductory Biology course last semester were miscalibrated for the first three exams: their predicted scores on exams were, on average, higher than their actual scores. Many students seemed to be unaware of their incomplete knowledge, even after completing the exam. This cognitive bias, in which unskilled individuals rate their ability much higher than is accurate, was named the Kruger-Dunning effect after it was formally described in 1999 (Kruger and Dunning, 1999). Kruger and Dunning found that the least competent individuals across multiple domains "grossly overestimated" their performance.

At the beginning of this semester, students listed the relatively ineffective "reviewing notes" as their primary study strategy. I hypothesized that reviewing notes as a primary study strategy may be contributing to students' inability to accurately determine what they do and do not know at the beginning of the semester. My goal this semester is to provide active practice opportunities to improve students' metacognitive awareness. The interventions described in this poster are evidence-based interventions (Hattie, 2013) implemented to enhance performance judgments without deflating motivation.

Goals

1. Investigate the self-assessment accuracy (calibration) of students enrolled in Introductory Biology I
2. Implement in-class activities that offer low-stakes, accurate feedback to students about their degree of knowledge and what "knowing" looks like.
3. Provide out-of-class active study activities and guidance to promote metacognition.
4. Measure the effects of these interventions on calibration, changes in study behaviors, and performance on summative assessments.

Methods

During the Fall 2014 semester, students were asked to predict their performance on exams both before taking the exam and directly after completing the exam. Multiple interventions were designed and implemented to promote self-reflection and calibration for the Spring 2015 semester. Students were polled about their primary study strategies at the beginning of the semester, before each exam, and after Exam II. Students were asked to predict their scores before each exam. I am currently investigating the effects of these interventions on calibration accuracy.

Fall 2014 Results

Miscalibration at the beginning of the semester

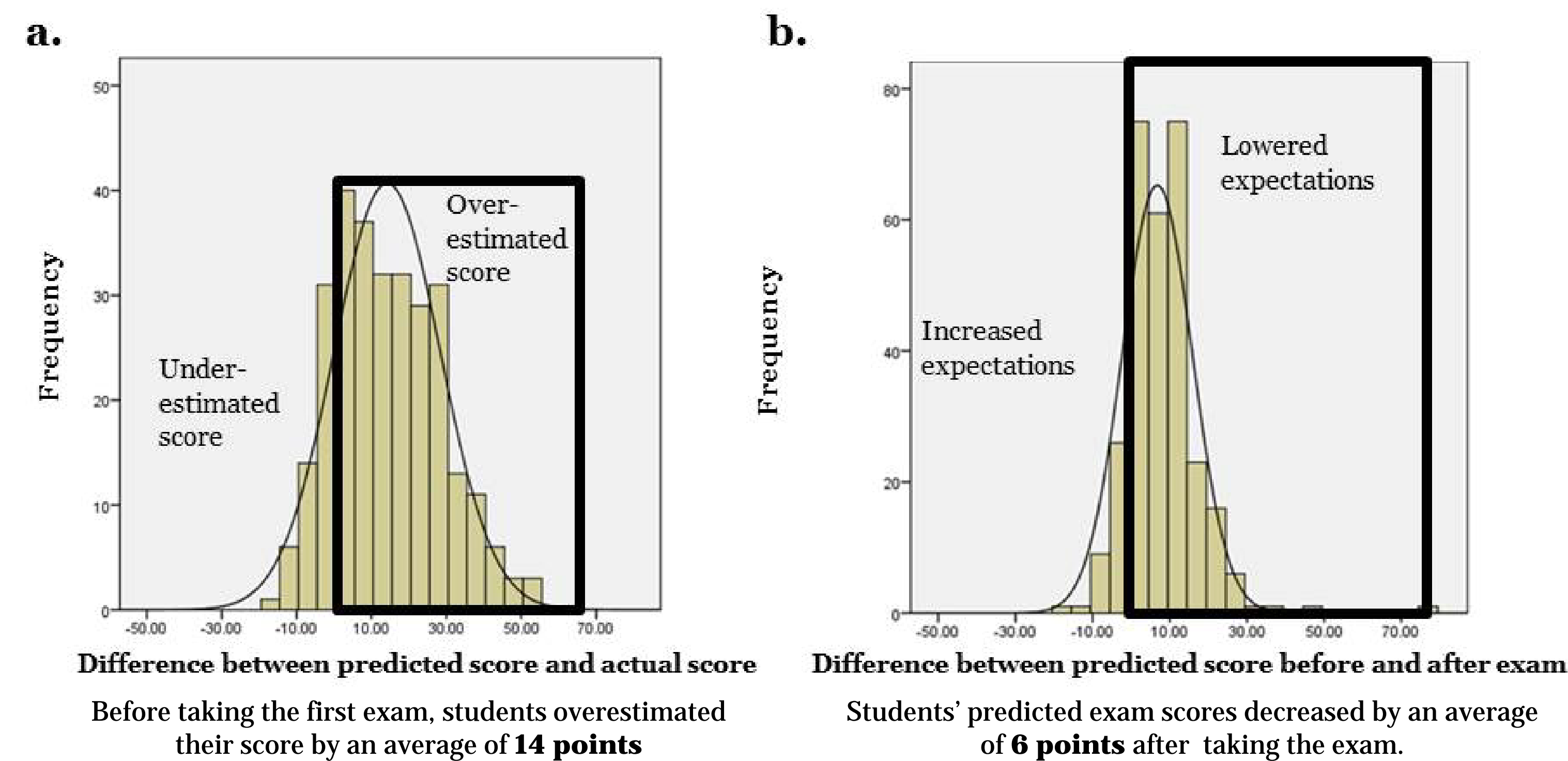


Figure 1: Students are miscalibrated in their self-assessments at the beginning of the semester. Before the first exam, students were asked to predict their score. Directly after taking the exam, students were asked to predict their score again. **a.** The predicted score before taking the exam was compared to the actual score earned on the exam. **b.** The difference between students' predicted score before and after the exam was plotted.

The Kruger-Dunning Effect

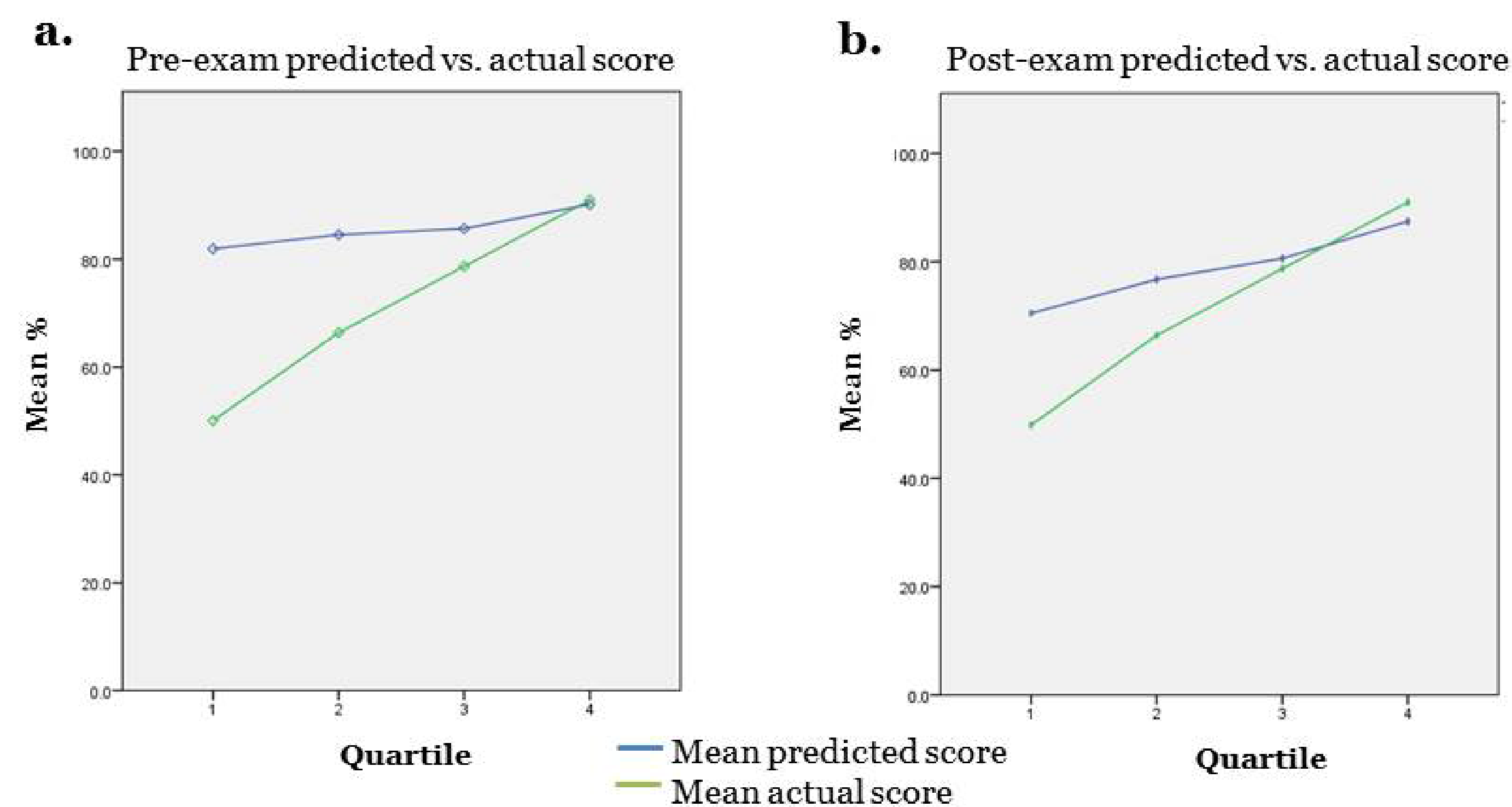


Figure 2: The lowest-performing students are the most miscalibrated. Students were divided into quartiles based on their performance on Exam I. **a.** Actual and perceived scores before taking the exam were plotted for each group. **b.** Actual and perceived scores after taking the exam were plotted for each group.

Calibration over the course of the semester

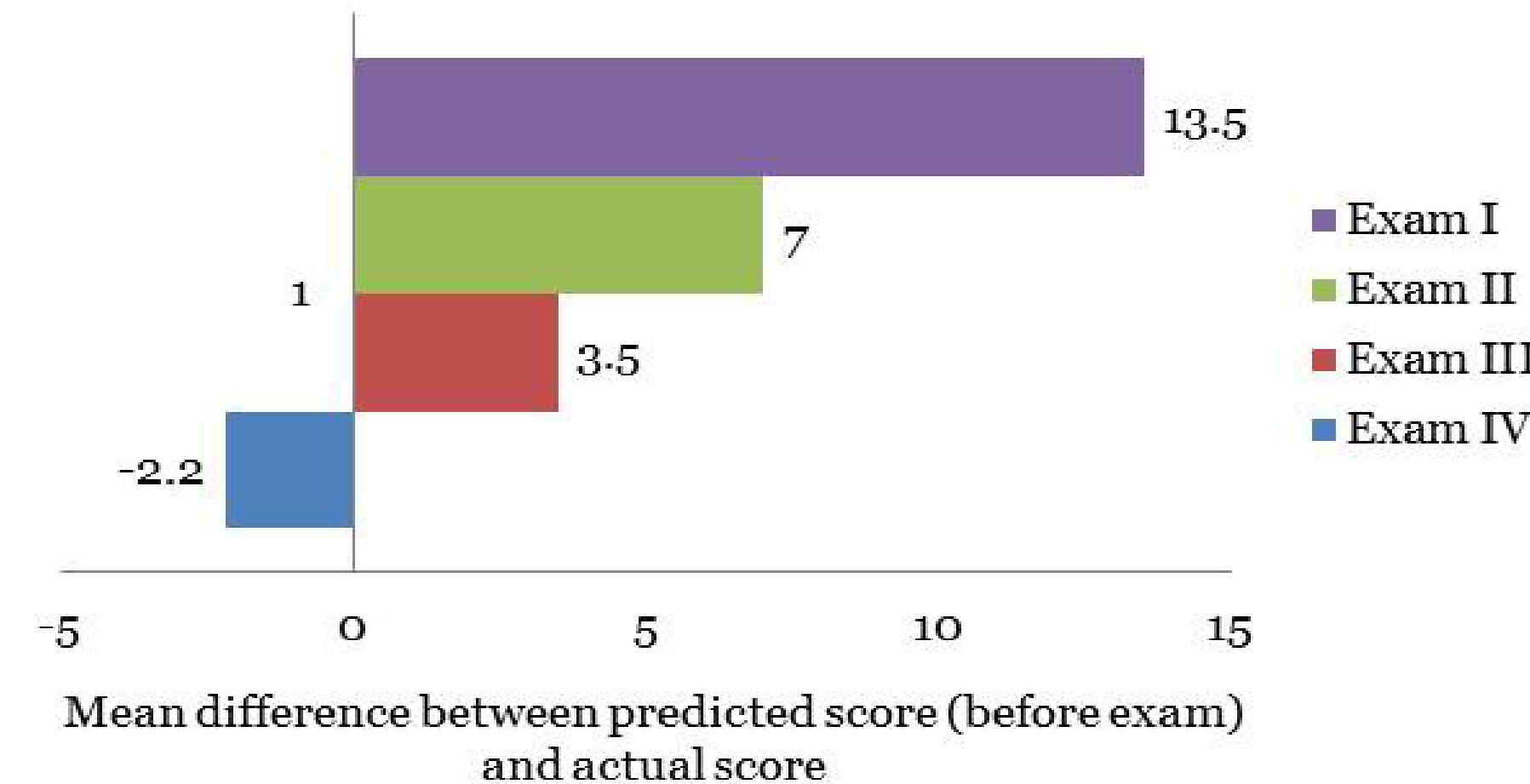


Figure 3: Calibration improves as the semester progresses. The mean difference between predicted score before taking the exam and actual score for each student was plotted for each exam.

Spring 2015 Interventions and Results

Several in-class activities, study guidance, and out-of-class resources are being used to promote accurate self-assessment this semester.

In-class activities:

- Active learning (clickers, case studies, etc.)
- Quizzes with group discussion
- Peer review/social comparison: students evaluate past students' answers, many of which illustrate misconceptions

Study guidance and out-of-class resources:

- *Provided extensive practice questions and practice exams.* For each exam, over 200 practice questions are provided. Answer keys provide feedback about correct and incorrect answers.
- *Described the 30/70 rule:* For maximum learning, 30% of students' study time should be spent reviewing material; 70% should be spent actively constructing knowledge and practicing skills
- *Described the self-regulation cycle:* students should monitor their understanding, evaluate why they answered practice and homework questions incorrectly, and adjust their study habits
- *Reworded learning objectives into active study activities* (e.g. modeling)
- *Set up study partners:* "A" students paired with struggling students
- *Implemented online Q and A board:* students anonymously post questions and I (or other students) answer

Preliminary Results:

- Students' primary study strategy changed from reviewing notes (70% first day of class) to completing practice questions (89% after Exam II)
- Exam I average increased 7 points from last semester (72% vs. 79%)
- On average, students overestimated their score on Exam I by **3 points**
- The lowest quartile overestimated their score on Exam I by **18 points** and highest quartile *underestimated* their score by **6 points**
- Second and third quartiles were well-calibrated for the first exam

Discussion and Future Directions

Key Findings:

- The majority of students were miscalibrated at the beginning of last semester – as a group, they tended to overestimate their performance
- The lowest performing students have the most inaccurate performance judgments (the Kruger-Dunning effect)
- Calibration improves as the semester progresses
- Study strategies used by students change as the semester progresses

Future plans:

- Measure the effects of interventions aimed at improving student calibration
- Determine if differences in calibration are associated with specific study strategies or approaches to learning

References

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